his collections from remote and little-known serpentine areas is the type specimen of *Haplopappus ophitidis* (J. T. Howell) Keck. An *Allium* collected by Freed is likely to be the type of a new species. Especially in the genus *Streptanthus,* in which he published two new species in 1952, Freed's numerous collections have increased greatly our knowledge of variation and geographic distribution.

When World War II ended and gasoline, as well as new vehicles, became readily available, Freed purchased a Jeep in which he and Jimmy traveled widely in search of serpentine and "Streps." Jimmy's death in June, 1953, following their return from an extensive collecting trip in the Southwest, was a blow from which Freed found it almost impossible to recover. A trip to the Piedmont of North Carolina to visit Jimmy's relatives and the thoughtful solicitude of friends finally restored in Freed his former interests.

On 7 April 1955 Freed married Blanche Lenora Griden, who survives him. Blanche's lively interest in Freed's botanical studies and her devoted care during the trying time of Freed's stroke and his lengthy and arduous convalescence have endeared her to those of us who came to know her through Freed.

Freed's ties with the profession of botany were primarily with members of the California Botanical Society and the personnel of the Herbarium at Berkeley. He corresponded rather regularly with Bacigalupi, Carter, Kruckeberg, McMillan, Mason, Morrison, and others interested in serpentine, *Streptanthus,* or both. His collections, his watercolor sketches, especially of Streptanthi, and his voluminous notes on various sections of this genus are on deposit in the Herbarium of the University of California at Berkeley.—John L. Morrison, State University, College of Forestry, Syracuse University.

CLEARED CARDIOCARPON LATE-ALATUM LESQ., CORDAITEAN SEEDS FROM MICHIGAN[1]

J. F. Davidson

Arnold (1948) described *Spermatites cylix* from the Big Chief No. 8 mine at St. Charles, Michigan, as appearing to be the apical portion of a very large spore. The present account may throw some light upon the nature of the object so designated, while extending our knowledge of the material previously identified (Arnold, 1949) as *Cardiocarpon latealatum* Lesq.

The Cordaitean seed that Lesquereux described as *Cardiocarpon latealatum* (1879, Pl. LXXXV, figs. 46, 47; 1880, p. 568) is a small, rounded, slightly cordate body, about 9 mm. wide and 10 mm. long. The nucule,

[1] This work was financed in part by a grant from the University of Nebraska Research Council.

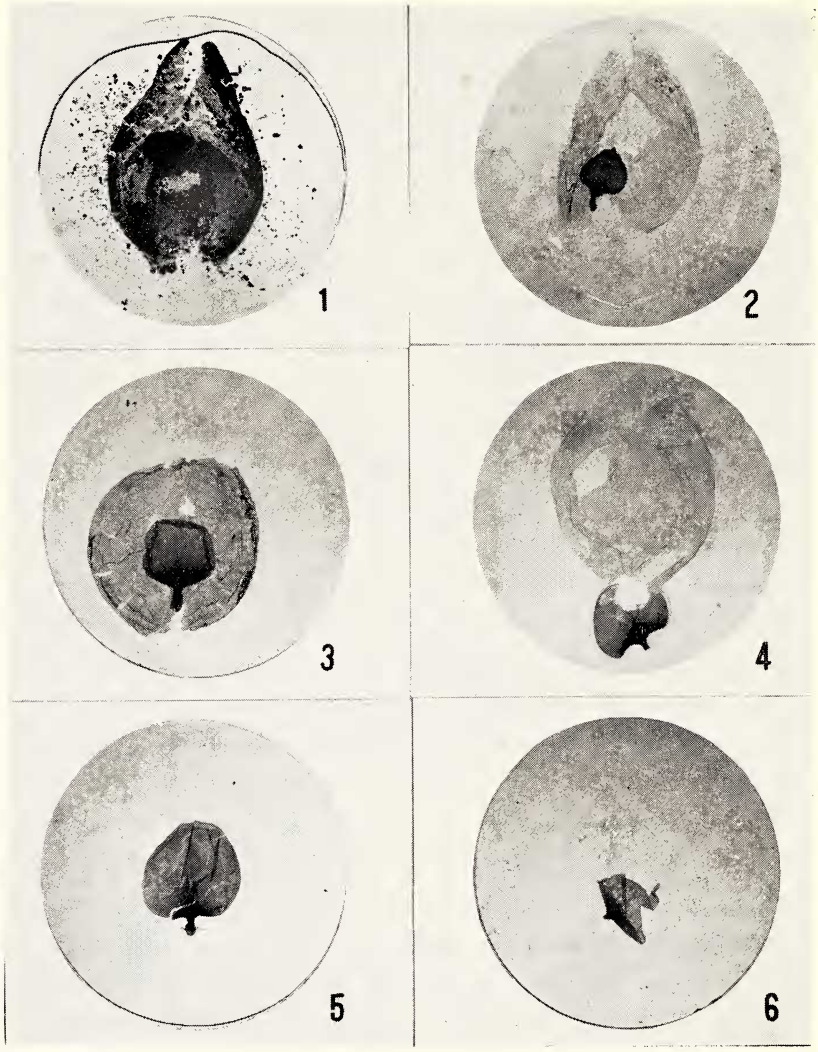
as figured, is about 5 mm. wide, and is surrounded by a marginal wing which varies from 2 to 3 mm. in width. The apical portion of the wing is only slightly prolonged. Lesquereux expressed uncertainty about the validity of the distinction between this species and *C. zonulatus* and *C. simplex,* all three being from the sub-conglomerate at Pittston, by saying: "Perhaps these three forms, separated as species, represent the same, although the differences appear evident" (1880, p. 569). Of these three species, however, the specimens from Grand Ledge, Michigan, which are discussed below, show the closest resemblance to Lesquereux' figures 46 and 47 which represent *C. late-alatum.* While Lesquereux was familiar with Brongniart's work in which the name *Cardiocarpon* was used for silicified seeds, he based his own separations on characters expressed in compressions.

In 1955, large numbers of *Cardiocarpon* seeds were collected at Grand Ledge, Michigan. These occurred in the shale immediately below what Kelly (1933) designated as "Cycle A" in his Pennsylvania stratigraphy. In the dried shale, the seeds could be studied only as compressions, but when freshly-collected shale was submerged in water the shale immediately started to disintegrate and some of the seeds, as well as other plant remains, could be recovered.

An attempt to clear the seeds with concentrated nitric acid and potassium chlorate (Schultz's solution) and 1 per cent ammonium hydroxide resulted in quite opaque preparations (fig. 1). This was apparently due to the intrusion of shale within the layers of the integument, and was eliminated by soaking the seeds in hydrofluoric acid previous to clearing. Such seeds were dehydrated in alcohol before mounting permanently in Diaphane.

In addition to the more or less complete seeds, several other isolated fragments were cleared. Some of these fragments were portions of the nucellar region of the seed, which showed no evidence of the previously-surrounding integument tissue. During the clearing and mounting process, the nucellar portions showed a strong tendency to become separated from their enveloping integuments. Since the cuticle of the integument is more delicate than that of the nucellus, it is logical that the latter would be occasionally preserved after the disintegration of the surrounding integument.

With the variation evident in these seeds, together with the variation originally recognized by Lesquereux, we are faced with two alternatives as regards the disposition of the specimens within our nomenclatural system. If we accept the names proposed by Lesquereux as denoting three species of Paleozoic seeds, then we can validly apply his names only to those specimens which agree exactly with his figured and described types. This implies that the vast majority of specimens which do not so agree will have to be described as new species. This might well be the case here. The alternative deals with probabilities. Since Lesquereux stated that his specimens from the same habitat were *possibly* conspecific, and since



FIGS. 1–6. *Cardiocarpon late-alatum* Lesq. (Circles are 18 mm. in diameter.) FIG. 1. Mature seed. (Without treatment with hydrofluoric acid, the intruded shale obscures detail. Other figures are cleared after treatment with hydrofluoric acid. Figures 2–5 show gradually increasing size of nucellus). FIG. 2. Nucellus, although displaced in clearing, shows apical beak. FIG. 3. Nucellus in position. FIG. 4. Displaced nucellus, showing heavily cutinized basal region. FIG. 5. Nucellus found free in the shale. The integument was not preserved. FIG. 6. Portion of the base of a nucellus, found free. (This is the kind of structure described as *Spermatites cylix* Arnold, the type of which was studied in comparison.)

comparable material has been found in another single habitat at Grand Ledge, it is *probable* that the variations encountered represent slight differences in the preservation process, and differences in the ages of the seeds when shed. The latter point is illustrated in the figures, which show variation not only in the over-all size of the seeds, but also in the size of the nucellar region. Were abortion involved, one might reasonably expect to find a series of small, aborted seeds and another series of more or less mature seeds, without the intermediate sizes.

Of the foregoing alternatives, the latter appears the more logical, and less apt to result in a confusion of names. In the material collected at Grand Ledge, some of which is figured here, it is assumed that the variation encountered represents differences in the maturity of individual seeds, and differential preservation of conspecific material. Thus it is here all referred to *Cardiocarpon late-alatum* Lesq.

The seeds from Grand Ledge are flattened, circular to ovate in outline, 9–15 mm. long by 9–11 mm. broad. The basal region shows an indentation at the point of attachment, which extends almost to the swollen basal stalk of the nucellus, while the distal end appears as a deeply bifid beak. The surface of the integument appears to be composed of roughly isodiametric cells, approximately 45 microns in diameter, except for those of the wing, which are about 20–25 microns broad and 60–100 microns long. The wing starts as a narrow band about 0.5 mm. wide near the base of the seed, and gradually increases in width upward to an observed maximum of 2.0 mm. In these specimens, the integuments, with the exception of the wings, were filled with clay, apparently bound with silica, since hydrofluoric acid dispersed it.

The nucellar body is very heavily cutinized, ovoid to globose, 2–7 mm. long, and equally broad. At the proximal end, a compact tissue of heavily-walled cells forms a saucer-shaped base (figs. 4, 5) which in turn arises from a short, 1 mm. long cylinder of similar cells in which no vascular tissue is apparent. The base of this cylindrical stalk is somewhat swollen, the cell walls are thinner, the cells are slightly larger and have a glandular appearance. The tendency for the nucellar portion to separate from the integument is shown in figures 2 and 4, while figure 5 shows the heavily cutinized base of the nucellus beginning to break away from the upper portion, in a specimen found without the surrounding integument. In figure 5 also may be seen the region of attachment of the nucellar stalk to the integument. Figure 6, which is one of the fragments found in the shale and cleared, is merely the basal portion of the nucellar region of a seed.

Although the apex of the nucellar body appears to be rounded in most specimens, closer examination shows that the specimens are incomplete. The smallest (fig. 2) and the largest (fig. 1) individuals show a definite attenuation at the apex such as might be expected to lead to a pollen chamber.

The specimen shown in figure 6 was compared with the type material

of *Spermatites cylix* Arnold, and they appear to be conspecific. Hence, *Spermatites cylix* probably refers to the basal portion of a nucellus from a Cordaitean seed comparable to *Cardiocarpon late-alatum*.

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THE BASIC CHROMOSOME NUMBER OF THE GENUS NEPTUNIA (LEGUMINOSAE-MIMOSOIDEAE)

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The genus *Neptunia* is composed of about ten or eleven species of annual and perennial herbs. Its members are widely distributed in the tropical and subtropical regions of the world. Five species are endemic to the Old World (three in Australia, two in India); two are cosmopolitan, occurring in wet habitats, principally in tropical regions; and three or four are confined to North and South America.

The region with the greatest number and diversity of taxa appears to be Texas and adjacent Mexico where four or five species are represented (Turner, 1951). From a standpoint of floral morphology, this area also retains one of the least modified species in the genus *(Neptunia lutea)*[1].

The first chromosome count reported for a species of the genus was by Dnyansagar (1952). He reported a number of n = 18 from sectioned anther material of the Indian species, *N. triquetra*. However, the camera lucida drawing documenting this count appears to show 18 somatic chromosomes and is perhaps but a portion of the complement of a single somatic cell of premeiotic "mother cell" tissue.

Turner and Beaman (1953) reported counts for three unnamed American taxa of *Neptunia* as 2n = 28. Their counts were obtained from somatic cells of sectioned root tip material. The only other report for the genus has been that of Frahm-Leliveld (1953) who listed an aproximate

[1] All of the described taxa in the genus, except this species, have some flowers with anantherous staminodia modified into petaloid structures. *N. lutea* has flowers with the stamens all alike and anther-bearing.